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Glossary

Application Site	The area within the red line Planning Boundary comprising the Onshore Transmission Works (OnTW), as defined.
Aquifer	A layer of water bearing rock
Colliery	A coal mine
Construction Compound	An indicative area within the Application Site used to accommodate the temporary work site including; construction parking, construction welfare facilities, construction meeting room, construction laydown and storage area, construction security facilities (fenced area/gate and security access) and construction security lighting.
Devensian Till	Fluvio-glacial deposits left after the retreat of glaciers or ice sheets during the Devensian Period (11,700 – 110,000 years ago). Typically comprising of unsorted clays and gravels (also referred to as Boulder Clay)
Diamicton	A terrigenous sediment that is unsorted to poorly sorted and contains particles ranging in size from clay to boulders, suspended in a matrix of mud or sand
EIA Report	Report presenting the findings of the Environmental Impact Assessment (EIA).
Faulting	A fracture in the rock resulting in an observable displacement
Groundwater Vulnerability	The vulnerability of groundwater to a pollutant discharged at ground level based on hydrological, geological, hydrogeological and soil properties
ICOL's Offshore Transmission Works (OfTW)	Offshore substation platforms (OSPs) and their foundations and substructures, interconnector cables and Offshore Export Cables. This refers to either the Consented OfTW or Revised OfTW, as defined.
ICOL's Offshore Wind Farm	This includes proposed wind turbine generators, foundations and substructures and inter-array cables. This refers to either the Consented Offshore Wind Farm or Revised Offshore Wind Farm, as defined.
Inter-granular fracture flow	Groundwater flow occurs through a combination of intergranular and fracture flow
Landfall	Point where up to two Offshore Export Cables from ICOL's Offshore Wind Farm will be brought ashore.
Made Ground	Infilled ground comprising of unspecified materials (often a combination of backfilled natural material and man-made deposits i.e. rubble)
Marine Beach Deposits	Shingle, sand, silt and clay; may be bedded or chaotic; beach deposits may be in the form of dunes, sheets or banks; in association with the marine environment
Micrograbbo	A medium grained basic hypabyssal igneous rock
Moderately Productive Aquifer	An aquifer system with moderate potential for groundwater abstractions, providing yield of up to 10 l/s
Offshore Export Cable	The subsea, buried or protected electricity cables running from ICOL's Offshore Wind Farm offshore substation to the Landfall.
Onshore Export Cables	Electricity cables from the Onshore Substation to the grid connection point.
Onshore Export Cable Corridor	The area within the Application Site where the proposed Onshore Export Cables will be laid.

Onshore Substation	The electrical substation comprising of all the equipment and associate infrastructure required to enable connection to the electrical transmission grid.
Onshore Transmission Works (OnTW)	All proposed works within the Application Site, typically including the Onshore Substation, cables transition pits, cable jointing pits, underground electricity transmission cables connecting to the Onshore Substation and further underground cables required to facilitate connection to the national grid. This includes all permanent and temporary works required. See <i>Chapter 5: Description of Development</i> for full details.
Original OnTW	The OnTW, as was granted planning permission in principle in September 2014, under ELC reference 14/00456/PPM.
Original OnTW ES	The Environmental Statement (ES) that was submitted to support the application for the Original OnTW in 2014.
Passage Formation	Cyclic sequence of sandstone, mudstone, seatearths and siltstone with ironstone and limestone bands
Port Setton Spittal Dyke	A Quartz Microgabbro rock
Quartz	A silica based mineral (SiO ₂)
Raised Marine Deposits	Gravel (shingle), sand, silt and clay; commonly charged with organic debris (plant and shell); now above the level of the present shoreline as a result of earth movement or a general fall in sea level
Scoping Opinion	The Scoping Opinion adopted by ELC as to the scope and information to be provided in support of an application for the OnTW, as defined.
Scoping Report	Report prepared as the first stage of the EIA process in support of a request for a Scoping Opinion from ELC, under Regulation 17 of the EIA Regulations. The Report was submitted in July 2017.
Site Investigation	Intrusive investigation to confirm geological, geotechnical and hydrogeological conditions
Site Walkover	Walkover of the Application Site and surrounds to identify current ground conditions, identify watercourses etc.
Storativity	The capacity of an aquifer to store and release groundwater
Syncline	A basin shaped fold in the dip of the strata
Transmissivity	The rate of flow of groundwater through a rock under a unit hydraulic gradient and unit width of aquifer
Water Dependent Ecological Site	A designated ecological site which is dependent upon either surface water or groundwater for its designation
Upper Limestone Formation	Sandstones, siltstones and mudstones with seatearths or seatclays and multiple coal seams. Sandstones are normally fine-grained and grey or pale yellow in colour but coarse-grained pebbly sandstones occur in parts.

Abbreviations and Acronyms

AEP	Annual Exceedance Probability
BGS	British Geological Survey
CAR	Controlled Activities Regulations
CEMP	Construction Environmental Management Plan
CMRA	Coal Mining Risk Assessment
DWS	Drinking Water Standards
EIA	Environmental Impact Assessment
ELC	East Lothian Council
ES	Environmental Statement
FRA	Flood Risk Assessment
GPP	Guidance for Pollution Prevention
GWDTE	Groundwater Dependant Terrestrial Ecosystems
ICOL	Inchcape Offshore Limited
LDP	Local Development Plan
mAOD	metres Above Ordnance Datum
NPF3	National Planning Framework 3
OnTW	Onshore Transmission Works
PPC	Pollution Prevention and Control
PPG	Prevention of Pollution Guidance
RBMP	River Basin Management Plan
SEPA	Scottish Environmental Protection Agency
SNH	Scottish National Heritage
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
TMP	Traffic Management Plan
WFD	Water Framework Directive

7 Hydrology, Geology, Hydrogeology

7.1 Introduction

- 1 This chapter of the Environmental Impact Assessment (EIA) Report assesses the potential impacts of the Inch Cape Onshore Transmission Works (OnTW) on hydrology, geology and hydrogeology.
- 2 The chapter describes the scope, relevant legislation, embedded mitigation, assessment methodology and the baseline conditions currently existing at the Application Site and the surrounding area (up to two kilometre radius). It then presents an assessment of the potential significant environmental impacts the OnTW would have on this baseline environment.
- 3 This chapter is supported by the following appendices:
 - *Appendix 7A Flood Risk Assessment (FRA);*
 - *Appendix 7B Coal Mining Risk Assessment (CMRA);*
 - *Appendix 7C Site Observation Photographs; and*
 - *Appendix 7D CAR Licences.*
- 4 A walkover of the site periphery and surrounding area was undertaken by an experienced SLR Technical Director who specialises in assessment of the water environment on 27 July 2017 to confirm the local site setting, drainage and to identify any notable water features present on site. It was not possible to gain access to the Application Site as remediation works of the former Cockenzie Power Station are ongoing.

7.2 Consultations

- 5 Scoping responses received from East Lothian Council (ELC), Scottish Environmental Protection Agency (SEPA), Scottish Water and the Coal Authority which were relevant to hydrology, geology and hydrogeology are summarised in Table 7.1 below, including Inch Cape Offshore Limited (ICOL) response and information as to where relevant information can be found within this EIA Report.

Table 7.1: Scoping and Consultation Responses and Actions

Consultee	Scoping/ Consultation Response	ICOL Response
Contaminated Land		
ELC (Contaminated Land Officer)	<i>"I have had a look at the Scoping Report and in particular with regards to the Hydrology, Geology and Hydrogeology section. Given the copious amount of data available as result of various investigations carried out for (but not limited to) the PPC Surrender Permit, I am satisfied that the proposals put forward (i.e. information review, assessment, further targeted SI and mitigation measures) will suitably address any potential contaminative impact on identified receptors as well as potential ground stability issues."</i>	This chapter presents data and information that characterises the baseline site setting, embedded mitigation and residual risk associated with contaminated land.
Protection of the Water Environment		
SEPA	<p><i>"SEPA requires that the scheme must be designed to avoid impacts upon the water environment. Where activities such as engineering works in the water environment cannot be avoided the EIA Report should include a map showing:</i></p> <ul style="list-style-type: none"><i>• All proposed temporary or permanent infrastructure overlain with all watercourses</i><i>• A buffer of at least 10 m drawn around each watercourse. If this buffer cannot be achieved each breach should be numbered on a plan with an associated photograph of the location, dimensions of the watercourse and drawings of what is proposed</i><i>• Detailed layout of all proposed mitigation including all cut off drains and settlement ponds</i> <p><i>Further advice and best practice guidance are available within the water engineering section of SEPAs website. Guidance on the design of water crossings can be found in our Construction of River Crossings Good Practice Guide. This map should include details of all proposed upgraded, temporary and permanent site infrastructure. This includes all tracks, excavations, buildings, borrow pits, pipelines, cabling, site compounds, laydown areas, storage areas and any other built elements.</i></p>	<p>This chapter has considered the effects on the water environment, including the requirement to avoid impacts on watercourses</p> <p>It is shown that with exception of the Landfall no works are required within or close to watercourses.</p> <p>Potential groundwater levels are considered and mitigation proposed to minimise the need for groundwater abstraction and for the control and management of surface water.</p>

Consultee	Scoping/ Consultation Response	ICOL Response
SEPA	<p><i>If water abstractions or dewatering are proposed, a table of volumes and timings of groundwater abstractions and related mitigation measures must be provided.</i></p> <p><i>Note that the proposed development may require an authorisation from SEPA under the Water Environment (Controlled Activities)(Scotland) Regulations 2011 (as amended) (CAR)."</i></p>	
Drinking Water		
Scottish Water	<p>Scottish Water notes that their records show no Scottish Water drinking water catchments or water abstraction sources which are designated as Drinking Water Protected Areas under the Water Framework Directive in the area that might be affected by the OnTW.</p> <p>Scottish Water notes that their records indicate the presence of a 10" steel water main within the Application Site.</p>	<p>Noted.</p> <p>Scottish Water plans have been obtained and are reviewed and assessed within the FRA (Appendix 7A). It is confirmed that no Scottish Water infrastructure lies within the Application Site. Checks for all services will be undertaken and services identified during the design phase of the OnTW and suitably accommodated (see Section 7.4).</p>

Consultee	Scoping/ Consultation Response	ICOL Response
Foul Waste		
Scottish Water	Scottish Water noted the presence of a 350 mm rising (pumped) combined sewer main within the Application Site, and a 1200 mm emergency sewer overflow which appeared to be just outside the Application Site boundary.	<p>Scottish Water plans have been obtained and are reviewed and assessed within the FRA (Appendix 7A). It is confirmed that no Scottish Water infrastructure lies within the Application Site.</p> <p>Checks for all services will be undertaken and services identified during the design phase of the OnTW and suitably accommodated (see Section 7.4).</p>
SEPA	SEPA noted : <i>“the site welfare facilities for the construction and operation of the development will be discharging directly to the Scottish Water foul water mains. Contact should be made with Scottish Water to determine the standards required to ensure adoption of new infrastructure and evidence should be provided with the EIA Report Scottish Water has confirmed the acceptability of the discharge to the foul water mains.”</i>	<p>Refer to Section 7.4 – The foul drainage will be designed and connection agreements reached with Scottish Water at the detailed design stage. The scale of facilities is envisaged to be relatively modest, and there is a very low risk that these flows would not be acceptable for discharge into Scottish Water mains.</p>

Consultee	Scoping/ Consultation Response	ICOL Response
Flooding and Groundwater		
SEPA	<p>Within the site SEPA Flood Maps have identified surface water and fluvial flood extents. SEPA believe that the fluvial flood extents shown on this map are possibly the result of demolition of the previous Cockenzie Power Station causing a depression. SEPA noted that there is a drainage ditch identified on the OS maps which is south east of the proposed development, and that this may be culverted through the development potentially causing this fluvial flood extent. SEPA will require that a Flood Risk Assessment (FRA) assesses all sources of flooding including fluvial and investigation into a potential culvert running through the development. SEPA advises that there should be no buildings erected over the culvert to ensure access if maintenance or repairs to the culvert are required.</p> <p>SEPA noted an approximate 1 in 200 year water level for the area of 3.96 mAOD based on extreme still water level calculations using the Coastal Flood Boundary Method. This does not take into account the potential effects of wave action, funnelling or local bathymetry at this location. SEPA also recommended that the applicant contact the Flood Prevention Authority with regard to the appropriate levels of freeboard for the area.</p>	<p>A Flood Risk Assessment is included as <i>Appendix 7A</i> and summarised in <i>Section 7.6.5</i> of this chapter. It considers all potential sources of flooding. The FRA considers the potential for a culvert to be present beneath the Application Site and concludes it's very unlikely to be present. The FRA includes an assessment of tidal flood risk and outlines appropriate mitigation measures.</p>

Consultee	Scoping/ Consultation Response	ICOL Response
SEPA	<p>SEPA advised that groundwater investigations should be updated due to the demolition of the previous power station, and that groundwater level data must be acquired for post demolition of the power station.</p> <p>SEPA also noted that excavations and other construction works can disrupt groundwater flow and impact on existing groundwater abstractions, and that the submission must include:</p> <ul style="list-style-type: none"> • A map demonstrating that all existing groundwater abstractions are outwith a 100 m radius of all excavations shallower than one metre and outwith 250 m of all excavations deeper than one metre and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it. • If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all existing groundwater abstractions affected. 	<p>Figure 7.4 outlines the regional hydrogeology and the location of licensed or private abstractions within a two kilometre radius of the Application Site.</p> <p>The elevation of shallow groundwater beneath the Application Site is also considered and assessed. See <i>Section 7.6.4</i>.</p> <p>An intrusive site investigation will be undertaken following completion of remediation works to confirm groundwater elevations.</p>

Consultee	Scoping/ Consultation Response	ICOL Response
ELC	<p>The East Lothian Council Shoreline Management Plan is available here: http://www.eastlothian.gov.uk/downloads/download/2303/shoreline_management_plan which contains information on coastal processes.</p> <p>Investigation of any formal and informal coastal defences will also be required and assessed as part of any Flood Risk Assessment. A Flood Risk Assessment for this site has previously been undertaken to support a previous redevelopment proposal for this site. There has been demolition since 2009 and as a result it is important to either update that Flood Risk Assessment or undertake a new one to determine the current and future risk of flooding at the application site and the potential impact of the proposed development on the risk of flooding elsewhere. The detailed Flood Risk Assessment should include the following:</p> <ul style="list-style-type: none"> • Investigation into the potential culverted watercourse through the site • Investigation into all sources of flooding including coastal, fluvial, surface water and ground water • Groundwater levels post demolition of the power station; and • Investigation into any coastal flood defences that may remain on site 	<p>To the extent relevant to the OnTW, the Shoreline Management Plan has been reviewed as noted in <i>Section 7.6.5</i> and within the FRA (<i>Appendix 7A</i>).</p> <p>A FRA has been carried out as part of this EIA Report (refer to <i>Appendix 7A</i>).</p> <p>An intrusive site investigation and coastal study will be undertaken in due course as outlined within <i>Section 7.4</i>.</p>

Legacy of Coal Workings		
Coal Authority	<p>Paragraph 147 of the Scoping Report notes that constraints might include the history of contamination of the site from past use for coal mining. The Scoping Report notes that a desktop study of the baseline environment, inclusive of mining, will be conducted and submitted as part of the EIA report. The embedded mitigation includes targeted site investigation information which will allow for a detailed design of the proposals to avoid destabilisation of mine workings.</p> <p>The eastern part of this site is within a Coal Authority Referral Area. This means an area that has been defined by the Coal Authority as containing potential hazards from former coal mining activity. These hazards can include: mine entries (shafts and adits); shallow coal workings; geological features (fissures and break lines) mine gas and previous surface mining sites. Although such hazards are seldom readily visible, they can often be present and problems can occur in the future, particularly as a result of development taking place.</p> <p>Information outlining how the former mining activities affect the proposed development should be included. A Coal Mining Risk Assessment (CMRA) will be required as part of the ES.</p> <p>The developer is advised to go to the Coal Authority website at http://coal.decc.gov.uk/en/coal/cms/services/planning/strategy/# and look for the “CMRA Model Template and Guidance”. The CMRA should be prepared by a competent person and include site specific information as well as information on how this affects the development and layout.</p> <p>Part of this development proposal lies within an area covered by The Coal Authorities Standing Advice. This area lies within a former coal mining area which may contain unrecorded coal mining related hazards. If any coal mining feature is encountered during development, this should be reported immediately to the Coal Authority on 0845 762 6848.</p> <p>Your attention is drawn to the Coal Authority policy in relation to new development and mine entries available at www.coal.decc.gov.uk. Please note that any intrusive activities which disturb or enter any coal seams, coal mine workings, or coal mine entries (shafts and adits) requires the prior written permission of The Coal Authority. Such activities could include site investigation boreholes, digging of foundations, piling activities, other ground works and any subsequent treatment of coal mine workings and coal mine entries for ground stability purposes.</p>	<p>The coal mining risks are assessed in this chapter on the basis of a Coal Mining Risk Assessment (CMRA) which is included as <i>Appendix 7B</i></p> <p>As noted in <i>Section 7.4</i>, a site investigation would be carried out as part of the detailed design of the Application Site, and stability and contamination issues would be accommodated in the final design.</p> <p>As noted in <i>Sections 7.8 and 7.9</i>, the works are not considered likely to impact on remnant coal mine workings or mining-related hazards.</p>

- 6 To inform the baseline setting of the Application Site requests for additional information beyond that included within the scoping response were submitted to both SEPA and ELC, who have provided the following information:
- SEPA has provided information on flood risk, tidal water levels, groundwater and surface water monitoring data (including quality, levels and flows) and details of nearby abstractions and discharges; and
 - ELC has confirmed that there are no private water supplies within a two kilometre radius of the Application Site.
- 7 In addition, freely available information from relevant bodies including the British Geological Survey (BGS), SEPA, Scottish Natural Heritage (SNH) and ELC has been consulted in defining the baseline and to help assess the potential impact of the OnTW.

7.3 Policy and Guidance

- 8 The following legislation and guidance are considered applicable to the OnTW and were taken into account during the assessment.

European Legislation

- 9 The key piece of European Legislation that protects the UK's water environment is the Water Framework Directive (2000/60/EC). This Directive protects all elements of the water cycle and seeks to enhance the quality of groundwaters, surface waters, estuaries and coastal waters.

National Legislation and Policy

- 10 Key national legislation and policy relevant to the OnTW includes:
- Scottish Planning Policy (SPP), Scottish Government, June 2014;
 - Water Environment and Water Services (Scotland) Act 2003;
 - Water Environment (Controlled Activities) Regulations 2011;
 - Scotland's Marine Plan, Marine Scotland, 2015;
 - Shellfish Directive (2006/113/EC);
 - The Groundwater Directive 2006/118/EC;
 - Groundwater Protection Policy for Scotland v3, Environmental Policy Number 19 (2009);
 - Environmental Protection Act 1990: Part IIA Contaminated Land, and associated Regulations and Scottish Government guidance;
 - Contaminated Land (Scotland) Regulations 2000;
 - The Town and Country Planning (Hazardous Substances) (Scotland) Regulations 2015; and
 - Radioactive Contaminated Land (Scotland) Regulations 2007, as amended, together with statutory guidance.

Local Planning Policy and Strategy

- 11 The currently adopted local planning policy is the East Lothian Local Plan (2008). The proposed ELC Local Development Plan (2016) is currently going through an examination process with the Scottish Government.
- 12 Key local policies relating to hydrology and hydrogeology include: Policy DP15 (Sustainable Urban Drainage Systems; and Policy D16 (Flooding).

National and Local Guidance

- 13 The following relevant UK guidance on good practice for construction projects was consulted when determining the embedded mitigation and during the assessment:
 - Pollution Prevention Guidelines (Scottish Environment Protection Agency, various dates);
 - Land Use Planning System – SEPA Guidance Note 31 (GWDTEs and Groundwater Abstractions), SEPA, October 2014;
 - Planning Advice Note PAN 33: Development of Contaminated Land (2000);
 - Planning Advice Note PAN 61: Planning and Sustainable Urban Drainage Systems (2001);
 - Planning Advice Note PAN 79: Water and Drainage (2006);
 - SEPA Land Use Planning System Development Plan Guidance Note 2a (2015);
 - SEPA Land Use Planning System Development Plan Guidance Note 2b (2017);
 - Land Use Planning System SEPA Development Plan Guidance Note 2e;
 - SEPA Planning Background Paper Flood Risk (2015);
 - SEPA Land Use Vulnerability Guidance (2012);
 - SEPA Planning Guidance: Strategic Flood Risk Assessment: SEPA technical guidance to support development planning (2015);
 - Scottish Government Online Planning Advice on Flood Risk (2015);
 - SEPA Land Use Planning System Guidance Note LUPS-GU3: Planning guidance on land subject to contamination issues (2012);
 - The SuDS Manual C753, CIRIA, 2016;
 - Environmental Good Practice on Site C692, CIRIA, 2010;
 - East Lothian Council Shoreline Management Plan (East Lothian Council, 2002); and
 - River Basin Management Plan for the Scotland River Basin District: 2015 – 2027 (Natural Scotland, Dec 2015)

7.4 Further Studies

- 14 Prior to construction several assessments and supporting documents will be produced to inform the detailed site design; these will include:

- a detailed site investigation; and
- a detailed drainage design.

7.5 Embedded Mitigation

- 15 Whilst the detailed design of the OnTW has yet to be finalised, the scheme proposals developed thus far have been developed following a review of the site history, including coal mining risk and hydrological setting. This information, which is described in the sections that follow, has informed the site design. In addition to the proposed site investigation, examples of embedded mitigation that have been included in the development proposals are:
- a site specific Coal Mining Risk Assessment (CMRA) has been completed and it has been confirmed that the OnTW is not located in an area that is considered to be at risk from previous deep or shallow mining;
 - a flood risk assessment was completed and used to inform the site design. The assessment considered all potential sources of flooding including tidal, fluvial and groundwater sources and the findings were used to set a minimum development level and assess tidal flood levels and required mitigation;
 - Scottish Water infrastructure plans were obtained and used to confirm that the proposed OnTW does not lie above key potable or foul water mains;
 - the OnTW will be constructed in accordance with best practice environmental and electrical supply industry guidance; and
 - provision has been made for a Sustainable Drainage System (SuDS) to collect, manage and treat runoff shed from the OnTW.
- 16 During construction, operation and decommissioning, site welfare facilities will be provided and foul water will be collected and discharged to Scottish Water foul water mains or a contained system prior to licensed disposal from the Application Site.
- 17 Works in the water (marine) environment associated with the Landfall of the Offshore Export Cables will only be undertaken in accordance with a design agreed with SEPA and in accordance with a Controlled Activity Regulations authorisation.
- 18 Any groundwater seepages intercepted by works associated with establishing foundations will be collected, treated and discharged in accordance with General Binding Rules published by SEPA.
- 19 Mitigation will be incorporated into all stages of the OnTW including design, construction, and operation and decommissioning, as outlined in Chapter 5: Description of Development.
- 20 A Construction Environment Management Plan (CEMP) will be developed and finalised following completion of the site investigation. Full details of the CEMP can be found in *Chapter 5: Description of Development*.

7.6 Baseline Environment

7.6.1 Study Area

- 21 The Study Area comprises the Application Site, centered at NGR 339400, 675400, together with a buffer area of up to two kilometre radius as shown on Figure 7.1.

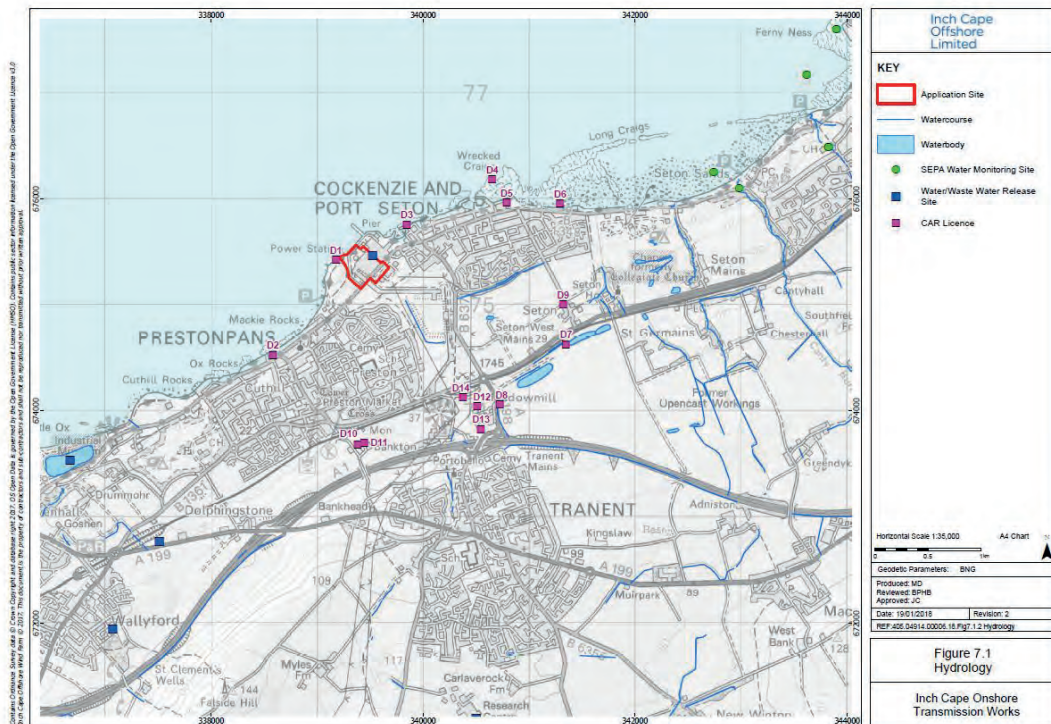


Figure 7.1: Hydrology

7.6.2 Data Sources

- 22 The following sources of information have been consulted in order to characterise the geology, hydrogeology and hydrology of the Study Area:
- BGS online maps (www.bgs.ac.uk/data/mapViewers/home.html) for details of geology, borehole logs and groundwater classifications;
 - Scotland's Environment Website (<https://www.environment.gov.scot>) for details of habitat mapping, environmental mapping including soil maps, coal mining reports, coastal, surface water and groundwater classifications;
 - Scottish Environment Protection Agency Website (www.sepa.org.uk) for details on flood risk and Water Framework Directive classifications for groundwater, rivers and coast;
 - Centre for Ecology and Hydrology Flood Estimation Handbook Web Service (<https://fehweb.ceh.ac.uk/>);

- The Coal Authority Website (<https://www.gov.uk/government/organisations/the-coal-authority>) for details on location and extent of historic coal mining;
- Scottish Natural Heritage for details on groundwater and surface water dependent designated sites (<http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/>);
- Ordnance Survey 1:25,000 scale Explorer Map (Viewed Online), (www.ordnancesurvey.co.uk);
- Information request response from SEPA, including details on flood risk, nearby abstractions, groundwater quality, surface water quality and surface water flows;
- Natural Scotland (2015) River Basin Management Plan; and
- Inch Cape Offshore Limited (2014) *Onshore Environmental Statement* used for additional background information.

7.6.3 Geological Setting

Superficial Geology

- 23 Review of BGS online mapping service¹ (included as Figure 7.2) indicates that the majority of the Application Site is underlain by Made Ground owing to the former operations as a coal fired power station. It is noted that the Application Site is currently undergoing the process of being remediated with much of the in-situ Made Ground being excavated, crushed and sorted. The final elevation of the Application Site upon completion of these works is at present uncertain, however it is anticipated that several metres of sorted and remediated Made Ground will remain beneath the development site.

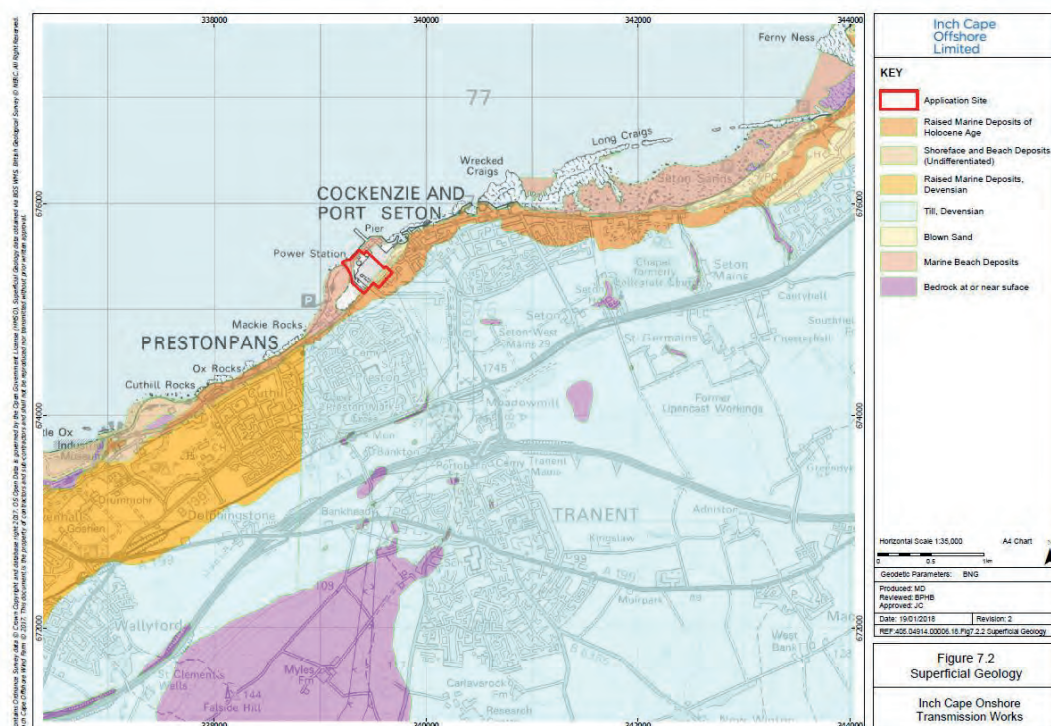


Figure 7.2: Superficial Geology

- 24 The northern boundary of the Application Site is underlain by Marine Beach Deposits (comprising Gravels, Sands and Silt) whilst the southern boundary is underlain by Blown Sand Deposits and Raised Marine Deposits (comprising Gravel and Sands). To the south of the Application Site the superficial deposits comprise Devensian Till Deposits primarily composed of Diamicton.

¹ BGS online mapping service GeoIndex (Accessed 11/08/17) <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

- 25 Local borehole records² indicate that insitu superficial deposits within the Application Site range in thickness from 3.5 – 5.4 m.
- 26 At the Application Site it is understood that the superficial deposits were removed prior to construction of the former Cockenzie Power Station. It is likely that the existing Made Ground lies directly on the underlying bedrock geology.

Bedrock Geology

- 27 The regional bedrock setting of the Application Site is shown in Figure 7.3.

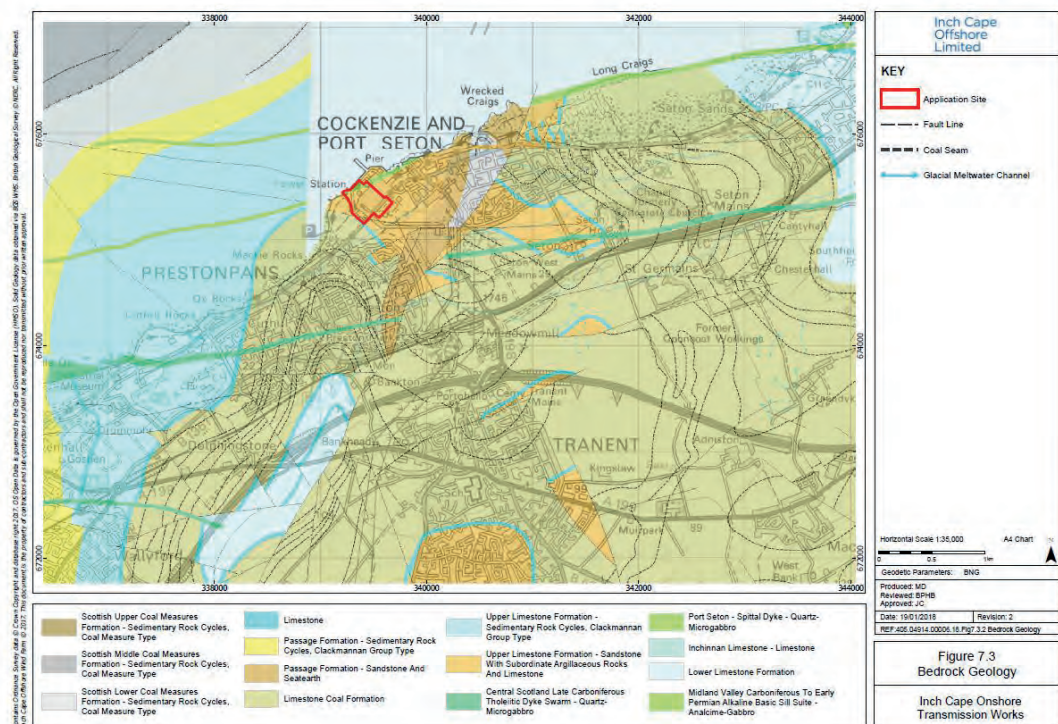


Figure 7.3: Bedrock Geology

- 28 The bedrock geology immediately underlying the Application Site comprises the Upper Limestone Formation and the Port Seaton-Spittal Dyke. The geological succession is summarised in Table 7.2 and discussed further in the Coal Mining Risk Assessment (see Appendix 7B).

² British Geological Survey Website (Accessed 11/08/17)
<http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

Table 7.2: Summary of Application Site Geology

Parent unit	Sub-strata	Lithological Description
Central Scotland Late Carboniferous Tholeiitic Dyke Swarm	Port Seton – Spittal Dyke & Late Carboniferous Tholeiitic Dyke Swarm	Quartz Microgabbro.
Scottish Coal Measures Group	Scottish Lower Coal Measures Formation	Sandstone, siltstone and mudstone in repeated cycles that most commonly coarsen upwards, but also fine upwards locally, with seatclay or seatearth and coal at the top. The mudstone and siltstone are usually grey to black, while the sandstone is fine- to medium-grained and off-white to grey. Coal seams are common and many exceed 0.3 m in thickness.
Clackmannan Group	Passage Formation	Cyclic sequence of sandstone, mudstone, seatearths and siltstone with ironstone and limestone bands.
	Upper Limestone Formation	Cyclic sequences of sandstones, siltstones, mudstones and thin marine limestones with seatearths.
	Index Limestone	Pale to dark grey bioclastic (crinoidal) marine limestone, with algal nodules.
	Limestone Coal Formation	Sandstones, siltstones and mudstones with seatearths or seatclays and multiple coal seams. Sandstones are normally fine-grained and grey or pale yellow in colour but coarse-grained pebbly sandstones occur in parts.

Coal Mining

- 29 A site specific Coal Mining Risk Assessment (CMRA) has been completed and is included as *Appendix 7B*. The CMRA provides an overview of the geological setting and details of historical coal mining within and around the Application Site.
- 30 The CMRA confirms that the Application Site is located within the likely zone of influence from four seams of coal at between 40 m and 200 m depth, associated with the Prestonlinks and Northfield Colliery, to the south-west, and Seton Colliery to the south. There are no mine entries recorded within the Application Site itself.

- 31 The CMRA confirms that there are no shallow coal workings beneath the Application Site and concludes that the overall risk to the Application Site from previous or historic coal mining is 'Low'.

Contaminated Land Risk

- 32 Any contaminated material, associated with the former use of the site as a power station will be removed as part of the former Cockenzie Power Station remediation and restoration programme required by the Pollution Prevention and Control (PPC) Permit surrender. A site investigation will be undertaken prior to detailed design of the Onshore Substation to confirm ground conditions.

7.6.4 Hydrogeological Setting

Recharge Mechanisms

- 33 The Met Office 1981 – 2010 climate average³ for the Royal Botanic Garden of Edinburgh, located approximately 15 km west of the Application Site, indicates that average annual rainfall in the area is about 700 mm.
- 34 Groundwater recharge across the Application Site and the surrounding area will be limited by the presence of low permeability superficial deposits (Till) and Made Ground.
- 35 Prior to remediation and restoration works being undertaken on the site of the former Cockenzie Power Station incidental rainfall was collected by a surface water collection system which routed the water to a pump house, from where it was discharged through an outlet within the seawall. Following completion of the remediation works it is likely that the final ground level will be below the surround ground elevations and any incidental rainfall will either gradually infiltrate through the Made Ground to the underlying strata or form overland flow, potentially discharging to the Firth of Forth via any retained outlets through the seawall.

Aquifer Designations, Characteristics and Vulnerability

- 36 Review of SEPA's River Basin Management Plan (RBMP) mapping⁴ indicates that the Application Site is underlain by the Esk Valley Sand & Gravel Groundwater Body. The Dalkeith Bedrock and localised Sand & Gravel Groundwater Body is situated 0.5 km to the south east of the Application Site.
- 37 In 2012, the Esk Valley Groundwater Body received an overall status of Good with Medium Confidence whilst the Dalkeith Groundwater Body received an overall status of Poor with Medium Confidence⁴.

³ Met Office Website (Accessed 11/08/17) <http://www.metoffice.gov.uk/public/weather/climate/gcynwfb7z>

⁴ SEPA River Basin Management Plan Mapping (Accessed online 11/08/17) <http://gis.sepa.org.uk/rbmp/>

- 38 The BGS hydrogeological Map of Scotland¹ indicates that the local bedrock geology (consisting of the Clackmannan Group and the Scottish Coal Measures Group) is recognised as a moderately productive aquifer with flow dominated by intergranular fracture flow.
- 39 The BGS open report ⁵ identifies the local bedrock aquifer as having discontinuous hydrogeological properties owing to the cyclical nature of the geology. Groundwater flow will occur in the more permeable sandstone strata whilst unmined coal seams as well as mudstone and siltstone strata will restrict flow. Significant faulting and historic mine workings within the bedrock geology may create preferential groundwater flow.
- 40 Voids created via mining activity (tunnels, shafts and adits) will artificially increase the transmissivity and storativity of the aquifer as well as creating preferential flow paths. Further changes to aquifer properties can occur where subsequent void collapse can deform the surrounding country rock.
- 41 Values for transmissivity range from 10-1000 m²/d dependent upon the degree of mineral extraction.
- 42 The groundwater vulnerability of the uppermost aquifer is classified as Vulnerability Class 4 (b, c and d) (High) with a small area of Class 3 (Moderate). Class 4 vulnerability is defined as 'vulnerable to those pollutants not readily adsorbed or transformed' whilst class 3 is defined as 'vulnerable to some pollutants; many others significantly attenuated'. The regional hydrogeology including vulnerability mapping is included on Figure 7.4.

⁵ BGS open report: Scotland's aquifers and groundwater bodies (Accessed online 11/08/17)
<http://nora.nerc.ac.uk/511413/>

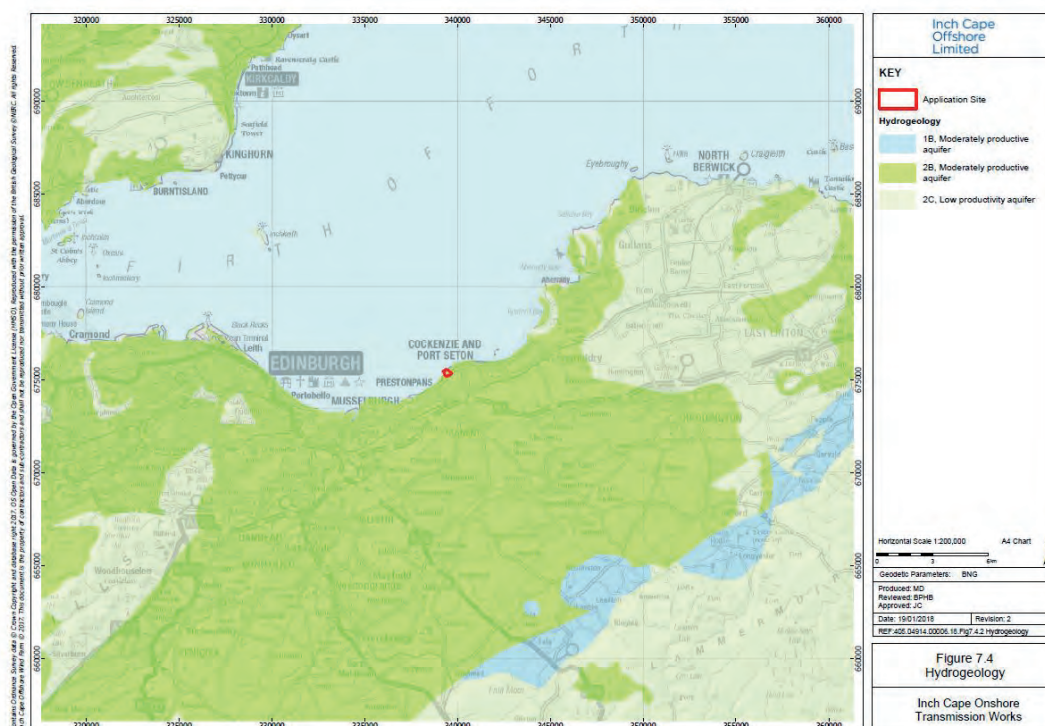


Figure 7.4: Hydrogeology

Groundwater Levels and Flow

- 43 SEPA has indicated that groundwater levels are currently not monitored within a two kilometre radius of the Application Site. The BGS has no borehole records within the Application Site boundary or surrounding area which indicate a depth to water table.
- 44 It is probable that there are two groundwater units present at the Application Site. A shallow groundwater system associated with the superficial deposits and a deep groundwater unit associated with the bedrock deposits. Water in the shallow groundwater unit will be in hydraulic with the Made Ground deposits and perched above the low permeability bedrock.
- 45 Groundwater flow in both groundwater units is likely to be toward, and discharge to, the sea.
- 46 It is understood that the former Cockenzie Power Station operated a pumped drainage system which pumped surface water run-off, as well as groundwater ingress from beneath the site. It is anticipated that this will have reduced groundwater levels in the shallow groundwater unit locally to the elevation of the concrete slab (c. 1.2 mAOD) which was installed below the former Cockenzie Power Station. Given that this drainage system has now been disused it is likely that groundwater levels will have rebounded to natural elevations.
- 47 Given the proximity of the Application Site to tidal waters of the Firth of Forth it is likely that since cessation of the pumped drainage system associated with the former Cockenzie Power Station, groundwater levels across the Application Site will now be controlled and be in

continuity with tidal levels in the adjacent Firth of Forth. The tidal range at Cockenzie⁶ is between 0.3 m and 5.9 m above Chart Datum (c.-1.8 mAOD to 3.5 mAOD)⁷ with a mid-tide elevation of 2.7 m above Chart Datum (0.6 mAOD).

- 48 Given the above, and based on a natural ground elevation of approximately 5 mAOD, it is anticipated that natural groundwater elevations in the shallow groundwater unit will likely be between c. 0.6 mAOD and 3.5 mAOD. For the purpose of this assessment a worst case groundwater water elevation of 3.5 mAOD has been assumed.
- 49 It is considered unlikely that the former Cockenzie Power Station intercepted or effected groundwater flow in the deep groundwater unit. Foundations associated with the Onshore Substation will be no deeper than the Power Station and thus not intercept the deep groundwater unit.

Water Abstractions and Groundwater Source Protection Zones

- 50 SEPA has provided details of Controlled Activities Regulations (CAR) licenses within a two kilometre radius of the Application Site; this data confirms that there are no water abstractions recorded within two kilometres of the Application Site.
- 51 ELC has confirmed that there are no known private water supplies within a two kilometre radius of the Application Site.
- 52 These data confirm the low productivity of the natural deposits in the Study Area.

Groundwater Quality

- 53 SEPA has provided groundwater quality data for a monitoring well located at Longniddry Golf Club (c. four kilometres east of the Application Site) covering a period from February 2014 to November 2016. Key monitoring data is summarised in Table 7.3 below.
- 54 Review of the BGS mapping for the area indicates that the monitoring well is located within the Clackmannan Group bedrock which extends beneath the Application Site and is therefore considered to be representative of the local groundwater quality in the deep groundwater unit.

Table 7.3: Summary of Groundwater Quality for Longniddry Monitoring Well

Determinand	UK DWS	Groundwater Quality (Feb 2014 – Nov 2016)			
		Count	Min	Average	Max
Aluminium (µg/l)		8	8	15.14	24.5
Alkalinity as CaCO ₃ (mg/l)		11	317	324.91	332

⁶ <https://www.tide-forecast.com/locations/Cockenzie/tides/latest>

⁷ Converted using data as provide within <http://www.ntsif.org/tides/datum>

Ammonia as N (mg/l)	0.39	11	0.143	0.15	0.161
Arsenic (µg/l)	10	9	<4.00		
Calcium (mg/l)		8	93	115.13	136
Cadmium (µg/l)	5	6	<0.03	0.02	0.022
Chloride (mg/l)	250	11	60.7	63.01	65
Chromium (µg/l)	50	9	<1.00		
Copper (µg/l)	2000	9	<0.30	0.36	1.3
Electrical Conductivity (µS/cm)		11	917	958.9	981
Iron (mg/l)	0.20	8	0.91	0.97	1.06
Potassium (mg/l)		8	4.46	4.59	4.85
Magnesium (mg/l)		8	45.5	46.43	47.4
Manganese (mg/l)	0.05	8	0.0535	0.06	0.0603
Sodium (mg/l)	200	8	33.2	33.74	34.2
Nickel (µg/l)	20	9	0.3	0.32	0.35
Nitrate as N (mg/L)	50	11	0.148		
Nitrite as N (mg/L)	0.10	11	<0.014		
Lead (µg/l)	10	9	0.2	0.3	0.35
pH (pH units)	6 - 9	11	7.31	7.63	7.97
Sulphate as SO ₄ (mg/l)	250	11	96.3	101.4	105
Zinc (µg/l)	5000	9	1.1	1.46	1.97

- 55 The monitoring data indicates that most key determinands were recorded below their respective UK Drinking Water Standards (DWS), with the exception of manganese which recorded slightly elevated concentration ranging between 0.0535 to 0.0603 mg/l, and iron which was recorded at concentrations of between 0.91 mg/l and 1.06 mg/l. As elevated iron and manganese concentrations are common within areas of coal mining this is not of immediate concern and considered to be reflective of natural background groundwater quality.

Water-Dependent Ecological Sites

- 56 The ecological setting is outlined within *Chapter 6: Ecology*, whilst water dependent ecology is summarised below.

- 57 Review of the Magic Map webpage⁸ indicates that the Application Site is located immediately to the east and west of the Firth of Forth Site of Specific Scientific Interest (SSSI), Ramsar Site and Special Protection Area (SPA).
- 58 These designations cover an area of coastal and estuarine habitats stretching along the Fife and East Lothian coastlines and extending inland as far as Alloa⁹. The designated area encompasses a variety of coastal habitats, including estuarine mudflats, saltmarshes, rocky shorelines and pebble beaches amongst others.
- 59 The Firth of Forth is noted for providing feeding grounds to internationally important numbers of wintering and migratory birds as well as having unique geological and geomorphological diversity.
- 60 There are no other water-dependent ecological sites within a two kilometre radius of the Application Site.

Landfill Sites

- 61 A review of Scotland's Environment Website¹⁰ indicates that there are no landfill sites located within the Study Area.

7.6.5 Hydrological Setting

- 62 The OnTW is situated on the southern shore of the outer Firth of Forth, in a marine setting.
- 63 There are no significant watercourses within a two kilometre radius of the Application Site.
- 64 The site inspection indicated that the B1348, passing south of the Application Site, provides an effective cutoff for any surface water flows that might originate from south of the road. The road grades gently to the west and to the east from near the Application Site, and would direct any surface water flows either towards Prestonpans or towards the Cockenzie Harbour area (see Photographs 01 and 02 within *Appendix 7C*).
- 65 A minor culverted drainage ditch is shown on OS mapping to be located c.0.5 kilometers to the south of the Application Site and immediately west of the Cockenzie coal store. The drainage ditch may convey runoff from the surrounding area northward towards the Firth of Forth. A site investigation undertaken as part of the Original OnTW ES found this minor watercourse to be overgrown and the drain not visible.

⁸ Natural England Magic Website (Accessed on 08/03/17)

<http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx>

⁹ Scottish Natural Heritage (Oct 2001) *Citation for Special Protection Area (SPA): Firth of Forth, Stirling, Clackmannanshire, Falkirk, Fife, West Lothian, City of Edinburgh, East Lothian (UK9004411)*

¹⁰ Scotland's Environment (Accessed 05/09/17)

<http://map.environment.scotland.gov.uk/seweb/map.htm?menutype=1>

- 66 SEPA have indicated that the culvert potentially runs beneath the Application Site. However, there was no evidence of the drainage ditch or culvert in proximity to the Application Site during the site walkover.
- 67 Further, an inspection of the vertical face of a retaining wall between the former Cockenzie Power Station base slab (still visible while the remedial works are under way) does not indicate any culverts or pipes outfalling into the Application Site (see Photograph 03 within *Appendix 7C*).
- 68 Given the findings above, and the former use of the Application Site, it is considered unlikely, that a culvert does lie beneath the Application Site. Regardless, the presence or otherwise of the culvert would be confirmed when access to the Application Site is possible and as part of the detailed Site Investigation.
- 69 The primary surface water features within the Study Area is the Firth of Forth to the north-west and Cockenzie Harbour located approximately 200 m to the north-east of the Application Site. Given that the Application Site is lower than the surrounding land there is not considered to be any hydraulic connection between the Application Site and the harbour.
- 70 The East Lothian Shoreline Management Plan¹¹ provides the following relevant information in regard to the coastline adjacent to the Application Site:
- The coastline generally in this area is accreting rather than eroding;
 - Future net sea level rise (considering climate change and other factors) is predicted to be five to six millimetres per annum. Over a 50 year timescale, this would equate to some 250 mm to 300 mm (0.25 to 0.30 metres);
 - The concrete and rock armour defences were estimated (as at 2002) to have more than a 50 year life; and
 - The preferred coastal defence option for this area is “Hold the Line” (no requirement or driver to either advance or retreat the shoreline), with minimal costs, associated with general maintenance, monitoring and replacement.
- 71 Other surface water features identified within a two kilometre radius of the Application site include:
- A small pond located c. one kilometre to the south east; and
 - A large pond is located approximately two kilometres to the south east of the Application Site and just south of the A198. This pond potentially provides drainage for outflow from the Blindwells Minewater Treatment Scheme located two kilometres to the south east of the Application Site.
- 72 There is not considered to be any hydraulic connection between the Application Site and either of these ponds.

¹¹ East Lothian Council Shoreline Management Plan (East Lothian Council, 2002)

Landform and Current Site Surface Water Management

- 73 Demolition of the former Cockenzie Power Station has been completed and excavation is taking place between ground level (c.5 mAOD) and the top of the concrete base pad (c.1.2 mAOD). From the site walkover it appears that the excavated materials are being crushed and sorted to separate materials such as metals and non-mineral substances from the soils, rocks and crushed concrete for off-site removal. The remaining materials are being re-placed and compacted across the Application Site.
- 74 Prior to construction of the Onshore Substation it is anticipated that the ground elevations will be raised to an elevation of approximately 3.5 mAOD regardless of the final reinstated landform.
- 75 As a consequence of the intercepting effect of the B1348 (Edinburgh Road) that runs south of the Application Site, the surface water catchment is limited to the Application Site itself.
- 76 It is understood that the site of the former Cockenzie Power Station utilised a pumped surface water management system. Run-off from the former Cockenzie Power Station drained to a sump within the concrete platform (which also received groundwater ingress) and was pumped and discharged to the Firth of Forth. Given that this system will have been removed it is considered that any incidental rainfall to the Application Site in its current condition will flow to the base of the workings and infiltrate to the shallow groundwater unit and discharge to the sea.
- 77 Between the Application Site and the coastline, a strip of some 10 m width remains. This area has a partially sealed surfacing. The John Muir Way footpaths runs along this strip (see Photographs 05 and 06 of *Appendix 7C*). No formal development is proposed across this area, although it is noted that the Offshore Export Cables will be routed under this area.
- 78 Along the northern edge of this strip are sea defenses that it is believed were constructed as part of the initial construction of the former Cockenzie Power Station. These defenses both retain the fill materials that were initially placed in this area, and provide erosion protection against wave and current action from the sea (see Photographs 07 and 08 of *Appendix 7C*).
- 79 These defences consist of a thick reinforced concrete seawall with a wave deflector at its upper edge, and with rock revetment outboard of the seawall (Rock Armour). There is no information available to confirm the foundation details of the seawall, and the drainage mechanisms through the seawall.

Surface Water Quality

- 80 SEPA does not monitor surface water quality within a two kilometre radius of the Application Site.
- 81 In response to an information request for surface water quality monitoring, SEPA has provided surface water quality data for the River Esk at Musselburgh Gauging Station, approximately six

kilometres from the Application Site. As the Application Site is located outside of the River Esk's catchment, this data is not considered relevant to this impact assessment.

Surface Water Abstractions and Discharges

- 82 SEPA has provided details of Controlled Activities Regulations (CAR) licenses recorded within a two kilometre radius of the Application Site. Details of the abstractions are included within *Appendix 7D* and locations are shown on Figure 7.1.
- 83 The data indicates that there are no surface water abstractions recorded within two kilometres; however, there are fourteen licensed discharges. These are typically for trade effluent purposes to watercourses; none of these are associated with the Application Site and none will impact on surface water features within the vicinity of the Application Site.

Flood Risk

- 84 A site specific flood Risk Assessment (FRA) has been undertaken and is included as *Appendix 7A*.
- 85 The FRA provides an overview of the Application Site setting and outlines the flood risk posed to the site from a range of potential sources including fluvial (rivers), pluvial (surface water), coastal (tidal or wave), groundwater and artificial drainage systems (surface water / foul sewers).
- 86 The potential flood risk to the Application Site is summarised in Table 7.4

Table 7.4: Potential Risks Posed by Flooding Sources

Source of Flood Risk	Flood Risk Assessment	Description
Fluvial	Little or No Risk	There are no watercourses in the vicinity of the site
Surface Water	Medium to High	The proposed development will be below surrounding ground level, run-off will therefore need to be managed to avert flooding
Coastal	Medium	The application site is defended by in-situ sea defences for events up to and including the 0.5 per cent Annual Exceedance Probability (AEP), however residual risk remains when including allowance for climate change / or for wave overtopping
Groundwater	Medium	Groundwater levels are anticipated to be in continuity with tidal levels and below the minimum development formation elevation, however residual risk remains if higher groundwater elevations are experienced

Artificial Drainage Systems	Low	There are no artificial drainage systems beneath the site and no drainage routes for offsite flooding to impact on the development site
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- 87 The FRA outlines appropriate mitigation measures to ensure that the medium risks are reduced to acceptable levels. This includes a SuDS and localised improvements to the current coastal defences.

7.6.6 Baseline Without the OnTW

- 88 The Scottish Government (National Planning Framework 3, June 2014) identifies the site of the former Cockenzie Power Station as a national development site for thermal energy generation, carbon capture and storage (National Development 3). NPF3 also identifies Cockenzie as a key location with opportunities for renewable energy-related investment, reflected by National Development 4 'High Voltage Electricity Transmission Network' in NPF3. ELC recognises that the site presents a key opportunity in terms of economic development and energy related investment and is seeking views on the most appropriate land uses for the site through its Local Development Plan (LDP) consultation exercise, which is at draft stage only at present and a separate Masterplan which was published in November 2017.
- 89 Until the draft LDP has been formally adopted by ELC it is difficult to predict the baseline in the absence of the OnTW. However, given the status of the site in NPF3 it is expected that the demolished site of the former Cockenzie Power Station will be redeveloped, most probably for some energy/industrial related purpose.

7.7 Assessment Methodology

7.7.1 Guidance and Methods

- 90 A qualitative risk assessment methodology has been used to assess the significance of the potential impacts associated with the OnTW. This methodology is specific to this chapter and is detailed below.
- 91 Two factors have been considered using this approach: the sensitivity of the receiving environment and the potential magnitude of impact, should that potential impact occur.
- 92 This approach provides a mechanism for identifying the areas where mitigation measures are required, and for identifying mitigation measures appropriate to the risk presented by the OnTW. This approach also allows effort to be focused on reducing risk where the greatest benefit may result.
- 93 Criteria for determining the significance of impacts are provided in Table 7.5, Table 7.6 and Table 7.7 below. Impacts of 'major' and 'moderate' significance are considered to be 'significant' in terms of the EIA Regulations.

- 94 The sensitivity of the receiving environment (i.e. the baseline quality of the receiving environment as well as its ability to absorb the impact without perceptible change) is defined in Table 7.5.

Table 7.5: Sensitivity Criteria for Geological and Water Environment Receptors

Sensitivity	Definition
Very High	International importance. Receptor with a high quality and rarity, regional or national scale and limited potential for substitution / replacement.
High	National importance. Receptor with a high quality, local scale and limited potential for substitution / replacement; or Receptor with a medium quality and rarity, regional or national scale and limited potential for substitution / replacement.
Medium	Regional importance. Receptor with a medium quality and rarity, local scale and limited potential for substitution / replacement; or Receptor with a low quality and rarity, regional or national scale and limited potential for substitution / replacement.
Low	Local importance. Receptor with a low quality and rarity, local scale. Environmental equilibrium is stable and is resilient to changes that are greater than natural fluctuations, without detriment to its present character.

- 95 The criteria that have been used to assess the magnitude of the impacts are defined in Table 7.6

Table 7.6: 'Magnitude of Impact' Criteria and Definitions

Magnitude	Criteria	Definition
Major	Results in loss of attribute.	<p>Fundamental (long term or permanent) changes to geology, hydrology, hydrogeology and water quality, such as:</p> <p>Permanent degradation and total loss of the soil habitats.</p> <p>Loss of important geological structure/features.</p> <p>Wholesale changes to watercourse channel, route, hydrology or hydrodynamics.</p> <p>Changes to the Application Site resulting in an increase in runoff with flood potential and also significant changes to erosion and sedimentation patterns.</p> <p>Major changes to the water chemistry or hydro-ecology.</p>

		Major changes to groundwater levels, flow regime and risk of groundwater flooding.
Moderate	Results in impact on integrity of attribute or loss of part of attribute.	<p>Material but non-fundamental and short to medium term changes to geology, hydrology, hydrogeology and water quality, such as:</p> <p>Loss of extensive areas or damage to important geological structures/features.</p> <p>Some fundamental changes to watercourses, hydrology or hydrodynamics. Changes to the Application site resulting in an increase in runoff within system capacity.</p> <p>Moderate changes to erosion and sedimentation patterns.</p> <p>Moderate changes to the water chemistry of surface runoff and groundwater.</p> <p>Moderate changes to groundwater levels, flow regime and risk of groundwater flooding.</p>
Minor	Results in minor impact on attribute.	<p>Detectable but non-material and transitory changes to geology, hydrology, hydrogeology and water quality, such as:</p> <p>Minor or slight loss of soils or slight damage to geological structures / features</p> <p>Minor or slight changes to the watercourse, hydrology or hydrodynamics.</p> <p>Changes to the Application Site resulting in slight increase in runoff well within the drainage system capacity.</p> <p>Minor changes to erosion and sedimentation patterns.</p> <p>Minor changes to the water chemistry of surface runoff and groundwater.</p> <p>Minor changes to groundwater levels, flow regime and risk of groundwater flooding.</p>
Negligible	Results in an impact on attribute but of insufficient magnitude to affect the use/integrity.	<p>No perceptible changes to geology, hydrology, hydrogeology and water quality, such as:</p> <p>No impact or alteration to existing important geological environs.</p> <p>No alteration or very minor changes with no impact to watercourses, hydrology, hydrodynamics, erosion and sedimentation patterns.</p> <p>No pollution or change in water chemistry to either groundwater or surface water.</p> <p>No alteration to groundwater recharge or flow mechanisms.</p>

96 The sensitivity of the receiving environment together with the magnitude of the impact defines the significance of the potential impact, as identified within Table 7.7.

Table 7.7: Significance of Potential Impact

Magnitude of Impact	Sensitivity			
	Very High	High	Medium	Low
Major	Major	Major	Moderate	Moderate
Moderate	Major	Moderate	Moderate	Minor
Minor	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

- 97 The characteristics of the impacts are described in terms of direct/indirect, temporary (reversible)/permanent (irreversible), together with timescales (short, medium, long term). These terms are defined within the Defined Terms.

7.7.2 Sensitivity of Receptors

- 98 Following a review of the current baseline conditions the potential receptors have been identified and the relative sensitivity of each of the receptors assessed as follows:

- Soils and geology: the underlying strata do not have any particular rarity or protective status. The sensitivity is therefore assessed as Low;
- Underground mining: historic underground mining is known to have taken place within the vicinity of the OnTW. The CMRA (included as *Appendix 7B*) indicates that there are historic workings located beneath the Application Site. These could potentially affect ground stability and act as preferential pathways for groundwater. The sensitivity of the receptor is therefore assessed as High;
- Groundwater: The sensitivity of both the shallow and deep groundwater units is assessed as Medium;
- Surface water catchments: the Application Site is not located within any named catchments, several minor drainage channels are identified which drain directly to either the Firth of Forth or the adjacent harbour. These are not assessed within the Water Framework Directive. The sensitivity is therefore assessed as Low; and
- Coastal / Tidal Waters: The adjacent Firth of Forth water body (classified as the Leith Docks to Port Seton Coastal Water body) has a moderate ecological potential. The sensitivity of the coastal waters is therefore assessed as Medium.

- 99 The above sensitivity values have been used within the impact assessment.

7.8 Impact Assessment - Landfall and Export Cables

- 100 During the construction phase, the Export Cables from the ICOL's Offshore Wind Farm would be brought ashore in the north west corner of the Application Site to Cable Transition Pits by either:

- trenching across the inter-tidal zone (perhaps with sheet-piling caisson style trench support) and tunnelling beneath the seawall, or;
- by use of directional drilling techniques from a point further offshore to the landward side of the seawall within the Application Site.

101 From the Transition Pits, either trenching or HDD would be used to install the Onshore Export Cables.

7.8.1 Effects of Construction

Surface Water Levels and Flow

102 Details of how surface water runoff will be managed will be outlined within the CEMP and will ensure that the overall impact on runoff rates is negligible.

103 Given the above the potential magnitude of impact is assessed as Minor. Given a sensitivity of 'Low' the overall significance of impact is therefore assessed as Negligible.

Coastal Waters

104 The construction of the Offshore Export Cables will include construction across the intertidal zone.

105 The construction will be undertaken in accordance with best practice and appropriate guidance to ensure that the construction phase is safe from a flood risk perspective and a water quality perspective.

106 In addition, given the possible flood risk associated with high tide and surge conditions, flood resilient materials and methods will be used for the Offshore Export Cables to prevent erosion of the backfilled material and exposure of the cables.

107 Given the embedded mitigation the magnitude of potential impact is assessed as Negligible, and the significance of impact on coastal waters, a receptor of Medium sensitivity is assessed as Negligible.

Surface Water, Groundwater and Coastal Water Quality

108 During the construction of the trenches for the Landfall of the Offshore Export Cables, there is the potential for surface water quality, groundwater quality or coastal water quality to be impacted. Potential sources of pollution include the release of suspended solids (surface waters and coastal waters), mobilisation of contaminants within any Made Ground (surface water, groundwater and coastal waters) and spillages during construction (surface water, groundwater and coastal waters).

109 The construction phase of the OnTW will be undertaken in accordance with the CEMP which will outline controls to ensure that there is no release of contaminants; this will include outlining surface water management measures, traffic management measures, provision of spill kits, etc.

- 110 To assess the potential for the presence of contaminated land within the locations of the Onshore Export Cables a site investigation will be undertaken prior to construction taking place; this will allow for the identification of any contaminated land and allow for appropriate remediation works and/or appropriate working practices to be identified. These would be included within the CEMP.
- 111 Given the embedded mitigation included in the form of the CEMP it is considered that the potential magnitude of impact from pollution is considered to be Minor. The overall significance of potential impacts is assessed as:
- Surface Waters (Low Sensitivity): Negligible
 - Coastal Waters (Medium Sensitivity): Minor
 - Groundwaters (Medium Sensitivity): Minor

Groundwater Levels, Flow and Recharge

- 112 The construction of the Onshore Export cables will require trenching or HDD. No data is available regarding groundwater levels across the Application Site however given the proximity to the Firth of Forth it is considered likely that the groundwater within both the limestone bedrock and shallow superficial / Made Ground deposits will be tidally influenced, and therefore potentially 2-3 m below ground level.
- 113 Given the relatively small size of the trenches / ducts (typically c. 1 m wide by 1.5 m to 3 m deep) the volume of any groundwater encountered during construction would be low and would be limited to the upper extent of the horizon. In the event that groundwater is encountered there may be a requirement for localised dewatering of the excavation to allow for the installation of the Onshore Export Cables, however it is considered that the impact on groundwater levels would be very localised and also of a very short duration. It is therefore considered that the potential magnitude of impact would not extend as far as any groundwater abstractions (none recorded within two kilometre of the Application Site). Given the above the magnitude of impact on groundwater levels or flow is assessed as Minor. Based on a sensitivity of Medium the overall significance of impact is also assessed as Minor.
- 114 The total extent of the landfall and Onshore Export Cables is very small and during the construction phase will not have any impact on groundwater recharge. If the trenches are found to be dry the open trenches will effectively act as soakaways for any incidental rainfall or runoff to the trenches. If dewatering is required the total volume of recharge lost is considered to be Minor. The potential magnitude of impact is therefore assessed as Minor with a corresponding Minor significance of impact based on the sensitivity of Medium.

Interception of Former Mine Workings

- 115 It is known that former coal mine workings are present across the regional area, however the CMRA has indicated that these are located at depths of more than 40 m below the Application Site. Given that all excavations associated with the Landfall and Offshore and Onshore Export

Cables will be shallow (less than three metres) the potential magnitude of impact is assessed as Negligible. Given the sensitivity of 'High' the overall impact is assessed as Negligible.

7.8.2 Effects of Operation and Maintenance

- 116 Following installation of the Onshore Export Cable the trenches will be backfilled to ground level and restored to pre-development conditions as far as practicable. There will therefore be no impact on surface water levels, flow or quality.
- 117 The trenches will be backfilled with excavated material and therefore in the event that groundwater was encountered, water levels will be allowed to rebound to pre-construction levels. It is therefore considered that the potential impact on groundwater levels and flow will be Negligible.
- 118 Similarly, groundwater recharge will not be affected as the ground will be restored to the pre-construction elevations and conditions and therefore both recharge and surface water runoff will not be affected.

7.8.3 Effects of Decommissioning

- 119 The decommissioning of the Onshore Export Cables will require largely the same approach as the construction phase, i.e. the digging of trenches to allow for the removal of the cables and then the re-instatement of excavated material.
- 120 The same approach will be taken as during the construction phase by explicitly following the CEMP. The potential impact to surface water flows and quality and groundwater levels, flows and quality are assessed as being the same as during the construction phase, i.e. Negligible.

7.9 Impact Assessment - Onshore Substation

- 121 The Onshore Substation will be constructed on the site of the former Cockenzie Power Station. The Onshore Substation does not directly impede upon the intertidal zone and therefore there is considered to be no potential impact on flows or tides along the coastal area, although the potential impact on water quality has been assessed.

7.9.1 Effects of Construction

Surface Water Levels, Flow and Runoff

- 122 Following the conclusion of remediation works across the site of the former Cockenzie Power Station it is likely that the ground conditions across the Application Site will comprise Made Ground only with no other features present. During the construction phase there will be the requirement for groundworks which could potentially include infilling, the construction of building foundations and laying of concrete; these have the potential to effect surface water flow routes and runoff rates.
- 123 During the construction phase surface water will be managed to ensure surface water runoff does not affect the construction of buildings or other infrastructure. Details of how surface

water runoff will be managed will be included within the CEMP and will include SuDS techniques, such as temporary sumps to collect and attenuate runoff prior to controlled discharge and monitoring the rate and quality of discharge from site.

- 124 Given the above the potential magnitude of impact on surface water levels, flow and runoff is assessed as Minor. Based on the sensitivity of Low the overall significance of impacts is therefore assessed as Negligible.

Groundwater Levels, Flow and Recharge

- 125 As noted in regard to the Landfall and Offshore Export Cables, the potential impact on groundwater levels, flow and recharge during construction of the Onshore Substation is considered to be Low. There will be a requirement for some excavations during the construction of the Onshore Substation which could potentially intercept any shallow groundwater. Given the nature of the Onshore Substation it is considered that any sub-surface working required will be relatively shallow and therefore the extent of any groundwater encountered will be minimal and readily managed.
- 126 In the event that groundwater is encountered there may be a requirement for localised dewatering of the excavation to allow construction to take place, however it is considered that the impact on groundwater levels would be very localised and also of a very short duration. It is therefore considered that the potential magnitude of impact would not extend as far as any groundwater abstractions (none are recorded within two kilometers of the Application Site). Given the above the magnitude of impact on groundwater levels or flow is assessed as Minor. Based on the sensitivity of Medium the overall significance of impact is also assessed as Minor.
- 127 It is considered that the impact on recharge will also be Minor because the total construction area (c.10 ha) is small in relation to the overall groundwater catchment (c.95 km²).

Surface Water, Groundwater and Coastal Water Quality

- 128 During the construction of the Onshore Substation there is the potential for surface water quality, groundwater quality or coastal water quality to be impacted. Potential sources of pollution include from the release of suspended solids (surface waters and coastal waters), mobilisation of contaminants within any Made Ground (surface water, groundwater and coastal waters) or spillages during construction (surface water, groundwater and coastal waters).
- 129 The construction phase of the Onshore Substation will be undertaken in accordance with the CEMP which will outline controls to ensure that there is no release of contaminants; this will include detailing surface water management measures, traffic management measures, provision of spill kits, etc.
- 130 Following the remediation works currently being undertaken on the site of the former Cockenzie Power Station it is assumed the site will be returned with any potential contaminated material either being removed or remediated prior to re-instatement. It is

therefore considered that there will be no in-situ contaminated material which could become mobilised as part of working the construction phase.

- 131 Given the embedded mitigation that will be included in the form of the CEMP it is considered that the potential magnitude of impact from pollution is considered to be Minor. The overall significance of potential impact is assessed based on the sensitivity of the surface water (Low), coastal waters (Medium) and groundwater (Medium). The potential impact for each of these is assessed as:

- Surface Waters: Negligible
- Coastal Waters: Minor
- Groundwaters: Minor

Interception of Former Mine Workings

- 132 The Onshore Substation will be constructed on the site of the former Cockenzie Power Station, which will be restored to a suitable development level using inert materials. Given that the Onshore Substation will require shallow footings it is considered that the Onshore Substation buildings will not extend below the base of the existing base slab and therefore there is no possibility that the Onshore Substation development will intercept any former mine workings. The potential for intercepting any former mine workings is therefore assessed as Negligible.
- 133 The potential magnitude of impact is assessed as Negligible. Given the sensitivity of High the overall significance of impact is assessed as Negligible.

7.9.2 Effects of Operation and Maintenance

Surface Water Levels, Flow and Runoff

- 134 At present there is no discharge of surface water run-off to surrounding watercourses or drains, with all surface water run-off ultimately discharged to the Firth of Forth to the north of the Application Site.
- 135 A permanent drainage system will be installed which will ensure that any surface water run-off generated by the Application Site continues to discharge to the Firth of Forth and there will be no increase in flows to the surrounding watercourses.
- 136 Given the commitment to use SuDS the potential impact on surface water levels and flows is assessed as 'negligible', based on a 'minor' magnitude of impact and 'low' sensitivity.

Flood Risk

- 137 As detailed within *Section 7.6.5* the Application Site is considered to be at potential risk of surface water, tidal and groundwater flooding; primarily due to the proposed elevation of the Application Site, which will be below surrounding ground levels.
- 138 Appropriate mitigation is outlined within the site specific FRA (*Appendix 7A*), which includes the following:

- it is anticipated that the Application Site will be set at an elevation of approximately 3.5 mAOD to ensure that the development level remains above the predicted maximum groundwater level;
- a surface water drainage scheme will be installed which will discharge to the Firth of Forth. The drainage scheme will also alleviate any residual groundwater flood risk; and
- within the Application Site a proposed berm at an elevation of c.6.2 mAOD will provide protection from tidal or coastal flooding.

139 Given this range of proposed mitigation measures, the potential magnitude of impact from flooding to the Application Site during the operational phases is assessed as Minor. Based on a sensitivity of the Application Site of High the overall significance of impact is assessed as Minor.

Groundwater Levels, Flow and Recharge

140 The proposed development levels of the Onshore Substation will be set at an elevation such that the development platform for the Onshore Substation remains above the underlying groundwater table and will therefore not require any ongoing regular pumping to manage groundwater levels and flood risk.

141 The Onshore Substation will not have any below ground development (with the exception of shallow foundations or wiring) and it is therefore considered that it will not directly affect groundwater flow. The potential magnitude of impact on groundwater flow is therefore assessed as Negligible. Based on the sensitivity of Medium the overall significance of impact is assessed as Negligible.

142 The area of the Application Site compared to the extent of the aquifer units beneath the Application Site is very small and as a consequence re-development would not have any material effect on groundwater levels, flow or recharge. The overall magnitude of impact is therefore assessed as Negligible with a corresponding Negligible overall significance of impact based on the sensitivity of Medium.

Surface Water, Groundwater and Coastal Water Quality

143 During the operation and maintenance phase of the OnTW the potential impact on water quality will be associated with either contaminants from road run-off (e.g. fuels) or from spillages during maintenance activities.

144 The drainage system will include measures to ensure the quality of any water discharged from the Application Site (to surface water, groundwater or coastal water). These will include measures to allow settlement of suspended solids and oil interceptors attached to any road drainage or areas where fuel hydrocarbon spills could occur.

145 Given this and the embedded mitigation (e.g. provision to discharge foul water to sewer, bunding of fuels, use of spill kits etc.) the potential magnitude of impact is assessed as Minor. Based on the sensitivity of the surface water (Low), coastal waters (Medium) and groundwater (Medium). The potential impact for each of these is assessed as:

- Surface Waters: Negligible
- Coastal Waters: Minor
- Groundwaters: Minor

7.9.3 Effects of Decommissioning

- 146 During the decommissioning phase of the OnTW the potential impacts are considered to be the same as during the construction phase and the same measures will be incorporated, i.e. following the approach as outlined within the CEMP and typical best practices.
- 147 The potential impact to surface water flows and quality and groundwater levels, flows and quality are assessed as being the same as during the construction phase which have all been assessed as Negligible or Minor.

7.10 Cumulative Impact Assessment

Cumulative Effects of Construction

- 148 During the construction phase each element of the OnTW has the potential to affect surface water flows, groundwater flow or surface or groundwater quality.
- 149 The probability of a pollution event occurring at more than one construction area at a time is considered to be very low, and given that all elements of construction will be undertaken in accordance with the CEMP the risk is further reduced. The cumulative effect on water quality is therefore assessed as Negligible. The required construction will not require any substantial groundwater abstraction or alterations to surface watercourses. The cumulative impact on surface water flows or groundwater flows is therefore assessed as Negligible.

Cumulative Effects of Operation and Maintenance

- 150 During the operational and maintenance phase there are not considered to be any potential cumulative impacts between the different elements of the OnTW given that the Landfall and Transmission Trenches will be backfilled and there is no potential risk to the water environment from this element of development.

Cumulative with Other Projects

- 151 It is judged that there are no cumulative impacts with other developments and the OnTW in relation to hydrology, geology and hydrogeology.

7.11 Impact Interactions

- 152 No impact interactions have been identified.

7.12 Additional Mitigation

- 153 As no significant impacts have been identified it is considered that no additional mitigation is proposed above and beyond the embedded mitigation, see *Section 7.5*.

7.13 Conclusions and Residual Effects

- 154 This assessment has confirmed the OnTW will be designed, constructed and operated in accordance with relevant best practice. As such the OnTW will not have a significant adverse impact on the surface water or groundwater environments.
- 155 A surface water drainage strategy has been outlined within the FRA (*Appendix 7A*) which will ensure that surface water run-off is managed so as to prevent flooding to the Application Site nor will the development increase flood risk to others.
- 156 The Application Site will be worked in accordance with the CEMP which will be agreed with statutory consultees prior to any construction commencing on site.

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